

WHAT IS CLAIMED IS:

1. A scanning stage apparatus comprising:
a table, the table being arranged to be positioned in a system vacuum chamber;
5 a first rod, the first rod being arranged to carry the table;
a first wall, the first wall having a first side;
a first plate, the first plate being arranged to support the first rod, the first plate
including an air bearing surface, the air bearing surface of the first plate further being
arranged to be held against the first side of the first wall by a first vacuum force;
10 a second plate, the second plate being arranged to support the first rod;
a first drive mechanism, the first drive mechanism being arranged to drive the first
plate to move the first rod in a first direction, the first drive mechanism further being
arranged to drive the second plate to move the first rod in the first direction; and
a second drive mechanism, the second drive mechanism including a second rod
15 and a first linear motor, the second rod being coupled to the first rod such that the second
rod is substantially perpendicular to the first rod, the second rod further being coupled to
the first linear motor, wherein the first linear motor is arranged to cause the second rod to
move the first rod in a second direction.
- 20 2. A scanning apparatus according to claim 1 wherein the first wall is a wall of the
system vacuum chamber, and the first side of the first wall is an exterior side of the
system vacuum chamber, and wherein the system vacuum chamber is arranged to
maintain a vacuum level therein.
- 25 3. A scanning apparatus according to claim 2 wherein the second plate, the first
drive mechanism, and the second drive mechanism are external to the system vacuum
chamber.
4. A scanning stage apparatus according to claim 3 further including:

a first sleeve, the first sleeve being in contact with the first plate, the first plate being arranged to support the first rod through the first sleeve, wherein when the first drive mechanism drives the first plate to move the first rod in the first direction, the first drive mechanism drives the first plate such that the first plate moves the first sleeve and the first rod; and

a second sleeve, the second sleeve being in contact with the second plate, the second plate being arranged to support the first rod through the second sleeve, wherein when the first drive mechanism drives the second plate to move the first rod in the first direction, the first drive mechanism drives the second plate such that the second plate moves the second sleeve and the first rod.

5. A scanning stage apparatus according to claim 4 wherein the first sleeve is in contact with the first plate through a first flexure bearing and the second sleeve is in contact with the second plate through a second flexure bearing.

6. A scanning stage apparatus according to claim 4 further including:
a force counteracting mechanism, the force counteracting mechanism being arranged to counteract atmospheric pressure forces on the first rod.

7. A scanning stage apparatus according to claim 6 wherein the force counteracting mechanism includes a constant force spring arrangement which is coupled to the first linear motor.

8. A scanning stage apparatus according to claim 6 wherein the table is coupled to a first end of the first rod, and the force counteracting mechanism includes a dummy vacuum chamber, the dummy vacuum chamber being arranged to substantially accommodate a second end of the first rod, the dummy vacuum chamber being arranged to maintain a vacuum level therein.

9. A scanning stage apparatus according to claim 8 further including:

a second wall, the second wall having a first side, the second wall being associated with the dummy vacuum chamber such that the first side of the second wall is an exterior side of the dummy vacuum chamber, the second plate including an air bearing surface, the air bearing surface of the second plate being arranged to be held against the first side of the second wall by a second vacuum force.

10. A scanning stage apparatus according to claim 6 wherein the first drive mechanism includes a second linear motor and a third linear motor, the second linear motor being arranged to drive the first plate, the third linear motor being arranged to drive the second plate.

11. A scanning stage apparatus according to claim 4 further including:
a first diaphragm, the first diaphragm being positioned between the first sleeve and the first plate; and
a second diaphragm, the second diaphragm being positioned between the second sleeve and the second plate.

12. A scanning stage apparatus according to claim 2 further including:
a second wall, the second wall having a first side, the second wall being associated with the system vacuum chamber such that the first side of the second wall is an exterior side of the system vacuum chamber, the second plate including an air bearing surface, the air bearing surface of the second plate being arranged to be held against the first side of the second wall by a second vacuum force.

13. A scanning stage apparatus according to claim 12 wherein the air bearing surface includes a preload area which provides force to the air bearing surface when the system vacuum chamber does not contain a vacuum.

14. A scanning stage apparatus according to claim 1 wherein the second drive mechanism includes a second linear motor, the second linear motor being coupled to the second rod.

5 15. An exposure apparatus comprising the scanning stage apparatus of claim 1.

16. A device manufactured with the exposure apparatus of claim 15.

17. A wafer on which an image has been formed by the exposure apparatus of claim
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18. A stage device, the stage device being arranged to scan a reticle in a vacuum environment, the stage device comprising:

15 a table, the table being arranged to accommodate the reticle thereon;
a rod, the rod having a first end and a second end, wherein the table is coupled to the first end of the rod;

a first plate, the first plate being arranged to support the rod, the first plate including an air bearing surface, the air bearing surface being arranged to at least partially held against an exterior wall of a system chamber by a first vacuum force;

20 a second plate, the second plate being arranged to support the rod;
a first drive arrangement, the first drive arrangement being arranged to drive the first plate and the second plate in a first direction, wherein driving the first plate and the second plate in the first direction drives the rod in the first direction;

a second drive arrangement, the second drive arrangement being coupled to the
25 first rod to drive the first rod in a second direction; and

a third drive arrangement, the third drive arrangement being coupled to the second drive arrangement, wherein the third drive arrangement is arranged to drive the first rod, the first plate, and the second plate in a third direction, and wherein the third drive arrangement, the second drive arrangement, the first drive arrangement, the first plate,
30 and the second plate are arranged to be substantially external to the system chamber.

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19. A stage device according to claim 18 wherein the second drive arrangement includes a second rod, a first coil, and a first magnet track, the second rod being coupled to the first coil, the second rod further being coupled to the first rod, the first coil being arranged to cooperate with the magnet track to drive the second rod and the first rod in the second direction.
20. A stage device according to claim 19 further including;
a first sleeve, the first sleeve being in contact with the first plate;
a second sleeve, the second sleeve being in contact with the second plate, wherein the first rod is arranged to translate in the second direction through the first sleeve and the second sleeve; and
a third sleeve, the third sleeve being coupled to the first rod, the second rod being positioned substantially within the third sleeve, wherein the first rod is arranged to translate in the first direction over the second rod.
21. A stage device according to claim 18 wherein the second drive arrangement is coupled to the second end of the first rod and the system chamber contains a vacuum, the stage device further including:
a force counteractor, the force counteractor being arranged to counteract atmospheric pressure forces on the first rod.
22. A stage device according to claim 21 wherein the force counteractor includes a spring arrangement, the spring arrangement being arranged to apply a force to the first coil to counteract the atmospheric pressure forces on the first rod.
23. A stage device according to claim 18 wherein the second drive arrangement is coupled to the first rod between the first end and the second end, and wherein the system chamber contains a first vacuum, the stage device further including:

a system chamber, the system chamber having a vacuum level, the system chamber including an external surface;

a table, the table being arranged to be positioned within the system chamber;

a rod, the rod being coupled to the table;

5 a first plate, the first plate being arranged to support the rod substantially outside of the system chamber, the first plate including a first surface that is substantially held against the external surface of the system chamber by a first vacuum force;

a second plate, the second plate being arranged to support the rod substantially outside of the system chamber;

10 a first actuator arrangement, the first actuator arrangement being arranged to drive the first plate and the second plate along a first axis, wherein driving the first plate and the second plate along the first axis drives the rod along the first axis; and

a second actuator arrangement, the second actuator arrangement being arranged to drive the first plate and the second plate along a second axis, wherein driving the first plate and the second plate along the second axis drives the rod along the second axis.

32. A scanning stage apparatus according to claim 31 further including:

20 a third actuator arrangement, the third actuator arrangement being coupled to the rod outside of the system chamber, the third actuator arrangement being arranged to drive the rod along a third axis.

33. A scanning stage apparatus according to claim 32 wherein the rod supports a sleeve and the third actuator arrangement includes a shaft which is at least partially positioned within the sleeve such that the rod is arranged to move along the third axis with the shaft and to move over the shaft along the first axis.

34. A scanning stage apparatus according to claim 32 wherein the second actuator arrangement is coupled to the third actuator arrangement.

35. A scanning stage apparatus according to claim 31 wherein the first plate supports the rod through a first sleeve and the second plate supports the rod through a second sleeve.

5 36. A scanning stage apparatus according to claim 35 wherein the first plate and the first sleeve are flexually attached to enable the rod to rotate about the first axis and about the second axis.

37. A scanning stage apparatus according to claim 36 wherein the first plate and the
10 first sleeve are attached using a bellows.

38. A scanning stage apparatus according to claim 36 wherein the first plate and the first sleeve are attached using a flexure bearing.

15 39. A scanning stage apparatus according to claim 31 further including:
a dummy chamber, the dummy chamber being arranged to maintain a vacuum level therein, wherein the rod is coupled to the table at a first end of the rod and a second end of the rod is positioned within the dummy chamber, whereby positioning the second end of the rod within the dummy chamber counteracts at least some atmospheric pressure
20 forces associated with the rod.

40. A scanning stage apparatus according to claim 39 wherein the dummy chamber includes an external surface and the second plate includes a first surface that is substantially held against the external surface of the dummy chamber by a second
25 vacuum force.

41. A scanning stage apparatus according to claim 31 wherein the second plate includes a first surface that is substantially held against the external surface of the vacuum chamber by a second vacuum force, and the table is coupled to the rod between
30 the first plate and the second plate.

42. A scanning stage apparatus according to claim 31 wherein the rod is a hollow rod, the hollow range being arranged to carry cables, the cables being coupled to the table.

5 43. A scanning stage apparatus according to claim 42 wherein the rod is formed from a material with a high specific stiffness.

44. A scanning stage apparatus according to claim 43 wherein the rod is formed from silicon carbide, the first plate is formed from alumina ceramic, and the second plate is
10 formed from alumina ceramic.

45. An exposure apparatus comprising the scanning stage apparatus of claim 31.

46. A device manufactured with the exposure apparatus of claim 45.

15 47. A wafer on which an image has been formed by the exposure apparatus of claim 46.

48. A scanning stage apparatus comprising:
20 a system chamber, the system chamber having a first vacuum level, the system chamber including a first external surface;

a dummy chamber, the dummy chamber having a second vacuum level, the dummy chamber including a second external surface;

a table, the table being arranged to be positioned within the system chamber;

25 a rod, the rod being coupled to the table, wherein a first end of the rod is positioned within the dummy chamber;

a first plate, the first plate being arranged substantially outside of the system chamber to support the rod, the first plate including a first surface that is substantially held against the first external surface of the system chamber by a first vacuum force;

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a second plate, the second plate being arranged substantially outside of the system chamber to support the rod, the second plate including a second surface that is substantially held against the second external surface of the dummy chamber by a second vacuum force;

5 a first actuator arrangement, the first actuator arrangement being arranged to drive the first plate and the second plate along a first axis, wherein driving the first plate and the second plate along the first axis drives the rod along the first axis; and

a second actuator arrangement, the second actuator arrangement being arranged to drive the first plate and the second plate along a second axis, wherein driving the first
10 plate and the second plate along the second axis drives the rod along the second axis.

49. A scanning stage apparatus according to claim 48 further including:

a third actuator arrangement, the third actuator arrangement being coupled to the rod outside of the system chamber, the third actuator arrangement being arranged to drive
15 the rod along a third axis.

50. A scanning stage apparatus according to claim 48 wherein the first plate supports the rod through a first sleeve and the second plate supports the rod through a second sleeve.

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51. A scanning stage apparatus according to claim 50 wherein a diaphragm is located between the first plate and the first sleeve.

52. A scanning stage apparatus according to claim 48 wherein the first actuator
25 arrangement and the second actuator arrangement are arranged substantially outside of the system chamber.

53. A scanning stage apparatus according to claim 52 wherein the dummy chamber is arranged to reduce leakage in the system chamber.

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54. A scanning stage apparatus according to claim 48 wherein the first surface of the first plate includes an area that is arranged to preload the first plate when the first vacuum level is a substantially zero vacuum level.

5 55. A scanning stage apparatus according to claim 54 wherein the second surface of the second plate includes an area that is arranged to preload the second plate when the second vacuum level is a substantially zero vacuum level.

56. An exposure apparatus comprising the scanning stage apparatus of claim 48.

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57. A device manufactured with the exposure apparatus of claim 56.

58. A wafer on which an image has been formed by the exposure apparatus of claim
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